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EXAMINER

MONDT, JOHANNES P

| ART UNIT | PAPER NUMBER |
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2826

DATE MAILED: 12/12/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/813,240

Applicant(s)

AMMON ET AL.

Examiner

Johannes P Mondt

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 September 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2 and 4-6 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2 and 4-6 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

Request for reconsideration filed 09/30/02 and entered as Paper No. 8 forms the basis for this office action. Comments on Remarks by Applicant are included under "Response to Arguments" below.

Response to Arguments

1. Applicant's arguments filed 09/30/2002 have been fully considered but they are not persuasive. In particular, the outgassing as described by Tamatsuka et al takes place under the melting conditions (see column 5, lines 58-61) for which Kuhn-Kuhnenfeldt et al. teach the 10 mbar (see column 2, lines 58-68), while it is inherent in the Czochralski method that the seed is pulled while rotating it slowly as it grows in the melt for the purpose of minimizing the thermodynamic load on the seed so as to prevent inhomogeneity in the composition of the crystal product; see, for instance a text book such as Streetman, Solid State Devices, Third Edition (1990), Chapter 1, page 14. A sudden change in the pressure or composition of the surrounding gas would be incompatible with this purpose and contradictory within the context of what is called the Czochralski method. Note particularly that the pulling takes place while the seed and the melt are in equilibrium by virtue of the seed being pulled from the melt. Therefore, the examiner maintains that the atmosphere during pulling is obvious over Tamatsuka et al in view of Kuhn-Kuhnenfeldt et al.

2. With regard to the range for the hydrogen content in claim 5 Applicant traverses but does not explain on which ground the traverse is based. As mentioned in the rejection of claim 5, it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233. Therefore, the burden is on the Applicant to show that said range is critical to the invention.

3. With regard to the citation of Kim et al, Applicant merely summarizes what in his opinion Kim et al teach, instead of traversing on specifics the examiner's rejection. On page 4 of the second Non-Final Office Action the examiner has given detailed references to Kim et al, as to the teaching of the heat shield. The examiner also has provided (a) motivation, (b) combinability and (c) reasonably justification for expecting success in implementing the combination. Applicant should have to base any reasonable traverse on these specifics.

4. With regard to the citation of the second Tamatsuka et al reference (6, 224,668) Applicant again lists the aspects contained in said second Tamatsuka et al reference rather than traverse in detail based on the specific arguments put forward by the examiner in support of the rejection (see pages 4-6).

In conclusion, the examiner regrettably has to maintains the present art rejections as the claim language that formed the basis for the second Non-Final Office has not been amended to overcome the rejections.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1. ***Claims 2 and 5*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Tamatsuka et al (6,291,874) in view of Kuhn-Kuhnenfeldt et al (4,330,361). Tamatsuka et al teach a method for producing a silicon semiconductor wafer comprising:

pulling a silicon single crystal from a melt in the presence of hydrogen (cf. column 6, lines 47-51) using the Czochralski method (cf. title, abstract, column 1, lines 58-63, and column 2, lines 19-38);

doping the silicon single crystal with nitrogen and producing a nitrogen concentration of 5×10^{12} to 5×10^{15} atoms cm^{-3} ; and

separating the silicon semiconductor wafer from the silicon single crystal (cf. abstract).

Tamatsuka et al do not necessarily teach the single crystal to be pulled under a hydrogen partial pressure of less than 3 mbar. However, Tamatsuka et al do disclose a partial hydrogen pressure of about 1/3 that of argon (cf. column 6, lines 50-51), while a partial pressure of argon of about 10 mbar is standard in the art, so as to reduce the

overall pressure of non-inert gases and yet have a cleansing flow, thereby reducing the occurrence of crystal defects, as evidenced by Kuhn-Kuhnenfeldt et al (cf. column 2, lines 62-65). Motivation for applying the same general range of partial noble gas pressure to the invention taught by Tamatsuka et al stems from the same overall inert gas pressure optimization. The inventions are combinable simply by adjusting the partial noble gas pressure, while success in doing so can be reasonably expected in view of the experience over decades with the CZ method.

With regard to claim 5: Tamatsuka et al teach the method to comprise subjecting the semiconductor wafer to a heat treatment in an atmosphere containing 75% argon and 25% hydrogen (cf. column 6, lines 47-56), instead of less than 3% as claimed by Applicant. The further limitation of claim 5 is thus not necessarily fulfilled by Tamatsuka et al, nor by Kuhn-Kuhnenfeldt et al. However, Applicant does not explain why the range for the hydrogen content of the argon-hydrogen atmosphere as defined by claim 5 is *critical* to his invention. Applicant is reminded that it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

2. ***Claim 4 is rejected*** under 35 U.S.C. 103(a) as being unpatentable over Tamatsuka et al and Kuhn-Kuhnenfeldt et al as applied to claim 2, in further view of Kim et al (5,942,032) and Tamatsuka et al (6,299,982) (previously made of record and henceforth denoted by "Tamatsuka2"). As detailed above, claim 1 is unpatentable over

Tamatsuka et al in view of Kuhn-Kuhnenfeldt et al, neither of whom, however, necessarily teach the further limitation of claim 4.

However, the use of a heat shield in the context of the Czochralski method for selectively shielding a semiconductor single crystal ingot is widely known in the art; see Kim et al (cf. abstract and claim 1 starting at column 10), which is closely related art, namely: the control of the composition of the silicon crystal grown using the Czochralski method. The purpose of the use of the aforementioned heat shield, namely the selective shielding of the monocrystalline ingot to control the type and number density of agglomerated defects in the crystal structure is fully relevant to the invention taught by Tamatsuka et al that aims at a reduction of the number of pits on the wafer surface (cf. column 1, lines 9-11), and therefore there exists ample motivation to combine the inventions. It is indeed possible to combine the inventions because the addition of a heat shield does not interfere with any of the requirements in the invention taught by Tamatsuka et al. Expectation of success is reasonable in view of the success of the use of heat shields in the context of the Czochralski method as shown by Kim et al.

Furthermore, although neither of the references cited in connexion with claim 2 necessarily teach the further limitation of cooling the silicon crystal from a temperature of 1050 to 900 degrees Celsius in less than 120 minutes, Tamatsuka et al in US Patent 6,299,982 B1, henceforth denoted by "Tamatsuka2" teach cooling defined by a range that is close to the one given in Applicant's claim, i.e., from 1150 to 1080, at a rate of 2.3 minutes or more, which falls in the range of Applicant's rate of 1.25 degrees per minute or more. Although the temperature range given by Tamatsuka2 is (slightly)

different from Applicant's, Applicant fails to show why his range is critical to the invention. Applicant is reminded that it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

3. ***Claim 6 is rejected*** under 35 U.S.C. 103(a) as being unpatentable over Tamatsuka et al and Kuhn-Kuhnenfeldt et al as applied to claim 2 above, and further in view of Tamatsuka et al (6,224,668) (previously made of record). As detailed above, claim 2 is unpatentable over Tamatsuka et al in view of Kuhn-Kuhnenfeldt, who, however, do not necessarily teach subjecting the semiconductor wafer to an oxidation treatment. However, the inclusion of oxygen as a reactant in the atmosphere during heat treatment within the context of the Czochralski method of producing a silicon single crystal wafer with reduced defects is well known in the art as exemplified by Tamatsuka et al (6,224,668) who teach the oxidation of a silicon substrate obtained as a wafer from a silicon ingot produced using the Czochralski method (cf. abstract) for the specific purpose of producing a silicon-on-oxide (SOI) substrate of use in SOI semiconductor technology, thereby not only producing the silicon layer but also the oxide layer and thus improving the efficiency of the SOI production process. Motivation is efficiency of production; combinability follows from the identically used crystal growth method to which the oxidation process is a mere addendum. Success can be reasonably expected in view of the circumstance that both ingredients in the overall process, i.e., the

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Czochralski method of crystal formation and the oxidation of a silicon layer, are well tested technologies.

Conclusion

3. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is 703-306-0531. The examiner can normally be reached on 8:00 - 18:00.


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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

JPM

December 6, 2002



NATHAN J. FLYNN
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